United States Department of Agriculture **Forest Service** **Southwestern Region Forest Health Arizona Zone Office**

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Subject: Evaluation of Desert Mistletoe Infection at Sabino Canyon Visitor Center and Santa Catalina RD Office (santacatalinard)

To: District Ranger, Santa Catalina RD

On March 18, 2005, I visited the Sabino Canyon Visitor Center and Ranger District office at the request of Bill Hart, fuels management specialist, and Bob LeFevre, hydrologist, to evaluate the incidence of desert mistletoe (*Phoradendron californicum*) infection in mesquite (*Prosopis*) and palo verde (*Cercidium*). Mistletoe infection is conspicuous in this area and is believed to be associated with dieback and some recent mortality. The evaluation was requested to determine the effects of mistletoe infection on the vegetation surrounding the buildings and parking areas and to provide recommendations to reduce impacts from this disease. This letter summarizes my observations and includes discussions on the biology, ecology, and control of mistletoe.

All trees surrounding buildings of the visitor center and district compound, parking areas, and shuttle pickup areas were surveyed for signs of mistletoe infection (Figure 1). Two trees were dead, both were mesquite with signs of heavy mistletoe infection and located on the edge of fairly recent (last 5 years or so) parking lot construction activity. Live trees were grouped by location, species, size, and infection (Table 1). Ninety-five of the live trees in the survey area were velvet mesquite and the other 11 trees were palo verde. Near the buildings, the size of trees did not appear to play a factor in whether or not mesquite was infected, as the percentages were not very different for trees <6" diameter root collar (drc) versus larger trees at 84% and 86%, respectively. However, larger trees tended to have a greater number and volume of mistletoe plants than the smaller trees. Most of the smaller trees tended to have 1 to 3 mistletoe plants unless there was a large female plant bearing fruit, and then there were more than 6 mistletoe infections. All groups of mesquite trees planted over the last 10 years had some level of mistletoe infection, but no infection was observed in recently planted palo verde.

Figure 1 Desert mistletoe on velvet mesquite in Sabino Canyon Recreation Area.

The lower infection rate (60%) of smaller-sized mesquite in the parking and trailhead areas is probably due to lack of infection in a few very young trees. However, 95% of the large mesquite trees in the parking area are infected; and most are severely infected, having several large fruit bearing female plants and multiple smaller infections.

Although some palo verde trees outside the survey area are infected with desert mistletoe, no infection was observed in palo verde during the survey.

Table 1. Incidence of desert mistletoe infection in velvet mesquite and palo verde at the Sabino Canyon Visitor Center and Ranger District office and parking area.

Location	Tree Species	Infected <6" drc	Uninfected <6" drc	% Infected (& Total) <6" drc	Infected >6" drc	Uninfected >6" drc	% Infected (& Total) Trees >6" drc
Buildings	Velvet Mesquite	16	3	84% (19)	13	2	86% (15)
Buildings	Palo Verde	0	6	0% (6)	0	1	0% (1)
Parking Area & Trailhead	Velvet Mesquite	6	10	60% (16)	43	2	95% (45)
Parking Area & Trailhead	Palo Verde	0	2	0% (2)	0	2	0% (2)

Desert Mistletoe Biology/Ecology

Desert mistletoe is a common parasitic plant on desert legume trees from southern Utah to northern México. The primary hosts are mesquite, ironwood (*Olneya*), palo verde, and acacia. Although desert mistletoe is a member of the group known as true or leafy mistletoes, desert mistletoe is nearly leafless. Mistletoes are dioecious, having separate male and female plants. The berry-like fruits produced on desert mistletoe female plants are small, red, and ripen during the winter. This mistletoe produces long pendulous stems, which eventually become dense bushes greater than one meter in diameter.

All true mistletoes are vectored by birds which eat the fruit and deposit seeds on the source tree or neighboring trees. Desert mistletoe seeds are dispersed primarily by phainopeplas (*Phainopepla nitens*), or silky flycatchers, although the berries are consumed by many other bird species such as mockingbird, Gila woodpecker, and American robin. Phainopeplas are unique in having a specialized digestive system that allows them to process hundreds of desert mistletoe berries in a day, as they feed almost exclusively on the ripe fruit from October through April. Phainopepla breeding failures have been linked to the absence of desert mistletoe berries due to

drought and freezing. Phainopeplas favor parasitized tall trees as perching and feeding sites and consequently deposit seeds disproportionately on trees with these characteristics. Their behavior leads to the patchy distribution of desert mistletoe infection. Desert mistletoe clumps are used for nesting by many bird species and are regarded as preferred nesting sites for phainopeplas.

Mistletoe seeds have a sticky coating which allows them to adhere to whatever they land on. Infection occurs when a seed lands and germinates on a small living branch with thin bark. The parasite grows through the bark and into the tree's water-conducting tissues, where rootlike structures called haustoria develop. Initially, these structures grow minimally into the wood itself, only enough to connect with the outer surface of the xylem, and then grow and extend with the annual growth of the host. It is this connection through which water and nutrients pass from the host to the mistletoe. Mistletoe shoots develop from haustoria that grow laterally through the host. It takes a minimum of two years before a new infection begins producing aerial shoots on the outside of the host plant and another two years before fruit production begins. Shoots become woody as they mature.

True mistletoes are connected to the host through xylem tissues. Since the shoots contain chlorophyll, they were thought to manufacture their own photosynthate, or food, and depend on their host plant for water and mineral nutrients. Researchers have recently found that true mistletoes acquire carbon from host xylem, with one species deriving more than 60% of its carbon from the host. This ability to obtain carbon from host xylem is aided by their high transpiration rates, higher than their hosts due to their ability to maintain greater osmotic potential over host tissues. The mistletoes high transpiration rates contribute to loss of vigor and dieback of hosts during water shortages (i.e., drought).

Recent studies have indicated host-specific races of *P. californicum* in Northern Baja California, Mexico, and southern Arizona. In Mexico, one race was found to infect primarily palo verde and acacia; and the other race was found to infect only mesquite. In Arizona, although mesquite is a primary host of desert mistletoe in some locations, it is uninfected in others, even though other host species may be severely infected. In the latter areas, mistletoe seeds are still dispersed on mesquite but infection does not occur.

Control Strategies

Site objectives need to be considered before desert mistletoe control strategies are determined. Mistletoes have long lifecycles, are slow to spread, and often take decades to cause mortality. It is often the unsightliness of mistletoe bushes in trees that people want to remove. Desert mistletoe is firmly established at the Sabino Canyon visitor center and Santa Catalina district office, but most of the trees are expected to survive for decades. There is some dieback in the larger heavily infected trees, and mortality of the worst of these is not unexpected over the next ten years. However, the fairly recent tree mortality found in the shuttle area was probably aided more by construction activity over the past five years than the mistletoe infection. Since many visitors come armed with binoculars to view birds, and phainopeplas are considered permanent rather than seasonal residents here, managing for bird habitat while maintaining screening and shade around buildings are likely objectives. The basic control strategies, discussed in detail below, are to prune infected limbs, remove mistletoe shoots, remove infected trees, and plant resistant species.

Limb Pruning

This treatment is only recommended in lightly infected trees in lightly infected areas. Remove infected branches at their point of origin or back to large lateral branches. Infected branches need to be cut at least one foot below the point of mistletoe attachment in order to completely remove embedded haustoria. Done properly, limb removal for mistletoe control can maintain or even improve tree structure. Severe heading (topping) is often used to remove heavy tree infestations; however, such pruning weakens a tree's structure and destroys its natural form. Severely infested trees should not be pruned, because they could die from losing too much crown.

Mistletoe Shoot Pruning

Mistletoe shoots can be cut flush with the limb or trunk. Since the root-like system is still embedded in the host tissue, mistletoe shoots immediately begin to grow again. Some tree workers wrap the area with a few layers of wide, black polyethylene to exclude light, with the idea that mistletoe will die within a couple of years without light. However, this treatment is often more unsightly than the mistletoe infection itself; and in some tree species, callus tissue will form under the plastic, further weakening the limb.

Simply cutting the mistletoe out of an infested tree each winter can be better than doing nothing if all trees within a given area are severely infected. Even though the parasite will grow back, stress is reduced, allowing the treated trees to live longer while replacement trees become established.

Resistant Species

As discussed above, research indicates there are races of desert mistletoe with host specificities. Since planted and mature palo verdes in the visitor center and office areas are not infected, they are assumed to be showing resistance and are a logical replacement tree.

Recommendations

Due to the high level of infection in this area, pruning infected limbs is not recommended. Too much tree canopy would be removed in severely infected trees, resulting in tree death due to pruning. Lightly infected trees are likely to have latent infections and/or get reinfected too quickly to make the pruning worthwhile. The direct removal of mistletoe shoots or bushes can reduce stress on infected trees, since mistletoe plants would no longer be transpiring as much water. However, it is labor intensive because mistletoe shoots start to grow back as soon as they are pruned, and the treatment needs to be repeated every two years or so. Since desert mistletoe infection was not observed in palo verde during the survey, it is assumed to be resistant or at least not as susceptible as velvet mesquite to the particular race of *P. californicum* in this area. Palo verde could be planted as the future replacement trees near severely mistletoe infected mesquite trees and also planted in the treeless areas of the parking lot perimeter.

If you have questions about this report, please email mfairweather@fs.fed.us or call me at (928) 556-2075.

/s/ Mary Lou Fairweather
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